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ABSTRACT

The reliability, validity, and factor structure of the Charles F. Kettering Scale, an instrument for the development of personnel and programs in schools, were investigated. The 40-item General Climate Factors section of the scale, a measure of educational environment, was completed by 30 administrators and teachers, 78 ninth graders, 66 eighth graders, and 83 seventh graders in a junior high school. Reliability was estimated, and coefficients were given. The Statistical Analysis System principal components program was used to examine construct validity. Five second-order factors represent the eight postulated scales of the instrument. Overall, data suggest that there are five "what is" subscales and three "what should be" subscales. The currently used subscale divisions may be inappropriate. Suggested refinements, including use of a five-point scale and different subscale divisions, may make the instrument more effective for a junior high population. Three tables present study findings. (Contains 24 references.) (SLD)

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A PSYCHOMETRIC ANALYSIS OF THE CHARLES F. KETTERING SCALE FOR A JUNIOR HIGH SCHOOL POPULATION

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ABSTRACT

This study investigated the reliability, validity, and factor structure of the Charles F. Kettering Scale, an instrument for the development of personnel and programs in schools. Refinements are offered to make the instrument more effective for a junior high school population.

A PSYCHOMETRIC ANALYSIS OF THE CHARLES F. KETTERING SCALE

The concept of school climate has been of continual interest to educational and psychological researchers and practitioners since the late 1960s. More recently, research on school effectiveness has generated a renewed emphasis on the importance of an educational environment in which optimal teaching and learning occurs (Good & Brophy, 1986).

They have been popular topics in the educational literature. Since climate studies look at the personnel and program components of a school environment, conceptual and operational definitions and measurement techniques have been diverse, however, prompting some to characterize organizational climate as a "fuzzy" concept (Guion, 1973). Nevertheless, there is agreement on several generalizations related to climate assessment.

The first generalization is that there is a core of activities organizations undertake to achieve their objectives, to maintain their internal environment, and to adapt to and maintain control over the "relevant" external environment (Argyris, 1970). The second point of agreement is that organizations are dynamic and that they operate in an historical perspective. The third generalization posits that for organizations to change, valid information on the actual status of the organization is necessary (Bennis, 1971).

Over the past several years, there have been various climate measures that have been frequently used and cited in the personnel and program development literature. The Kettering instrument is one such scale. It is composed of four sections: Part A, General Climate Factors (40 questions); Part B, Program Determinants (35 questions); Part C, Process Determinants (40 questions); and Part D, Material Determinants (15 questions) (Howard, Howell, & Brainard, 1987).

The General Climate Factors section of the instrument consists of eight subscales: (1) respect (Items 1-5), (2) trust (Items 6-10), (3) high morale (Items 11-15), (4) opportunity for input (Items 16-20), (5) continuous academic and social growth (Items 21-25), (6) cohesiveness (Items 26-30), (7) school renewal (Items 31-35), and (8) caring (Items 36-40). Five questions (variables) comprise each subscale of the instrument. The scaling technique used is two discrepancy-format columns. Each column has four descriptors: 1 = almost never, 2 = occasionally, 3 = frequently, and 4 = almost always.

METHOD

Two hundred fifty-seven junior high school students, teachers, and administrators in a major school district in the Southwestern United States completed Part A, the General Climate Factors section, of the Kettering instrument. Thirty administrators and teachers, 78 ninth graders, 66 eighth graders, and 83 seventh graders comprised the junior high school population. All students sampled were from middle class backgrounds.

RESULTS

We used the SAS principal components program (SAS Institute, Inc., 1986) to examine the construct validity of the General Climate Factors section of the Kettering instrument. Nunnally (1967) noted that some researchers refer to construct validity as "factorial validity."

Because the Kettering instrument uses two discrepancy-format columns, we performed two separate first order principal components analyses, one for the "What Is" (left) side of the scale and one for the "What Should Be" (right) side of the scale. Using

Kaiser's (1960) criterion, the "What Is" analysis yielded twelve factors with eigenvalues greater than or equal to 1.0, while the "What Should Be" analysis isolated eight factors. The twelve prerotation eigenvalues for the "What Is" part of the scale were as follows: 8.78, 2.00, 1.61, 1.49, 1.41, 1.37, 1.31, 1.13, 1.12, 1.07, 1.04, and 1.02. The eight prerotation eigenvalues for the "What Should Be" part of the scale were as follows: 13.97, 1.44, 1.41, 1.34, 1.32, 1.21, 1.08, and 1.04.

One result of these analyses was a matrix of correlations among the factors. The interfactor correlation matrices can be factored just as the two 40 x 40 intervariable correlation matrices can be. This method is called second-order factor analysis.

Kerlinger (1984) wrote that "while ordinary factor analysis is probably well understood, second-order factor analysis, a vitally important part of the analysis, seems not to be widely know and understood" (p. xiv). However, Kerlinger (1984), Thompson and Borrello (1986), and Thompson and Miller (1981) published examples of applications utilizing both primary and second-order factor findings.

The decision to extract second-order factors was driven by the finding that the first-order varimax solutions involved numerous multiple loadings, suggesting a first-order oblique solution as well as a second-order result. An approximate check as to whether a loading is statistically significant can be obtained by doubling the standard error, i.e., doubling the critical value for significance for an ordinary correlation. The statistically significant value for a sample size of 257 is approximately .32 (Stevens, 1986). Very often in research, the minimum value is set at 0.3 in absolute magnitude. See Table 2 for the first-order varimax rotated factor pattern matrices.

TABLE 1
VARIMAX ROTATED FACTOR PATTERN MATRICES
FOR "WHAT IS" AND "WHAT SHOULD BE" SCALE ITEMS (n = 257)

What Is

Item	Scale	1	2	3	4	5	6	7	8	9	10	11	12
1	Respect	0.072	0.036	0.024	0.095	0.022	0.152	0.165	-0.035	0.032	0.047	-0.027	0.774
2		0.171	-0.022	0.286	0.181	0.046	0.191	0.111	-0.139	0.038	0.615	0.090	-0.118
3		-0.201	0.278	-0.076	0.122	0.470	0.047	0.176	0.044	0.026	-0.267	0.358	-0.050
4		-0.035	0.329	-0.156	0.096	0.065	-0.041	-0.077	0.207	0.081	0.634	0.093	0.242
5		-0.055	0.129	0.188	0.202	0.260	0.425	0.066	-0.042	0.127	0.359	-0.037	0.020
6	Trust	0.135	0.198	0.223	0.533	0.055	0.153	0.080	0.157	-0.074	0.259	-0.156	-0.096
7		0.312	0.187	0.053	0.442	-0.099	-0.159	0.397	-0.067	0.111	0.203	-0.121	0.071
8		0.045	0.401	0.180	0.276	-0.117	0.378	0.091	0.106	0.094	0.084	-0.077	0.008
9		0.173	-0.006	-0.014	0.687	0.163	0.174	0.033	0.047	0.144	0.041	0.151	0.089
10		0.106	-0.074	0.033	0.031	0.060	0.155	0.658	-0.067	0.122	0.190	0.103	0.283
11	High Morale	0.143	0.063	0.689	0.156	0.132	0.115	0.149	0.236	0.059	0.060	-0.008	-0.050
12		0.016	0.088	0.391	0.159	0.115	0.514	0.005	0.039	0.095	0.167	0.137	0.158
13		0.067	0.033	0.031	0.050	0.133	0.051	0.043	0.725	0.027	0.088	-0.023	-0.160
14		0.205	0.028	0.054	0.052	-0.119	0.131	0.125	-0.020	-0.001	0.088	0.779	-0.043
15		0.459	0.048	0.074	0.184	0.110	0.444	-0.097	0.116	-0.241	0.184	0.159	0.057
16	Input	0.232	0.199	0.227	0.065	0.557	0.183	0.154	-0.071	0.107	0.009	-0.259	0.168
17		0.155	-0.040	0.151	0.020	0.729	-0.015	-0.008	0.189	0.013	0.150	0.017	-0.021
18		-0.052	0.092	0.087	0.152	0.094	0.043	0.619	0.191	0.007	-0.134	0.044	-0.033
19		0.255	0.013	-0.192	0.160	0.484	0.200	0.107	-0.160	0.198	-0.074	-0.016	-0.061
20		0.457	0.221	0.196	0.252	0.216	0.307	0.114	0.046	-0.160	-0.164	-0.008	0.036
21	Growth	0.102	0.109	0.349	0.297	0.401	-0.049	0.077	-0.014	0.185	0.231	-0.044	0.051
22		0.025	0.034	0.340	0.501	0.196	0.115	0.183	0.090	0.170	0.096	0.234	0.132
23		0.022	0.043	0.122	0.070	-0.093	0.124	0.152	0.667	0.147	-0.110	0.077	0.158
24		0.182	0.385	0.403	0.174	0.160	0.165	0.161	-0.056	0.144	-0.028	0.166	-0.216
25		0.015	0.034	0.244	0.038	0.323	0.049	-0.047	0.208	0.390	0.098	0.443	0.109
26	Cohesiveness	0.536	0.133	0.209	0.089	0.059	-0.120	-0.092	0.191	-0.259	-0.048	0.309	0.286
27		0.231	0.250	0.009	0.150	-0.010	0.529	0.014	0.046	0.195	-0.062	0.189	0.226
28		0.118	0.450	0.033	0.189	0.192	0.041	0.198	0.058	0.320	0.064	0.025	0.080
29		0.132	0.004	0.118	0.092	0.072	0.190	0.183	0.032	0.739	0.101	0.038	-0.025
30		0.396	0.264	0.517	-0.072	-0.006	0.121	0.042	0.009	0.212	0.071	0.167	0.146
31	Renewal	0.182	0.710	0.146	-0.094	0.068	0.120	-0.085	-0.074	0.043	0.121	0.063	0.149
32		0.135	0.307	0.120	0.141	0.145	0.013	-0.122	0.229	0.534	-0.028	-0.013	0.076
33		0.268	0.584	-0.009	0.147	-0.000	0.101	0.168	0.187	-0.031	0.059	-0.027	-0.229
34		0.234	0.036	0.007	-0.070	0.073	0.546	0.329	0.258	0.146	-0.005	0.014	-0.026
35		0.147	0.352	0.279	-0.043	0.102	0.009	0.444	0.317	-0.032	0.038	0.060	0.037
36	Caring	0.522	0.194	-0.056	0.215	0.080	-0.028	0.007	0.122	0.167	0.022	0.060	0.116
37		0.368	0.366	0.350	0.348	-0.020	0.180	-0.020	-0.116	0.054	-0.107	0.038	0.175
38		0.707	0.205	0.020	-0.054	0.192	0.149	0.140	-0.015	0.089	0.078	0.064	0.048
39		0.685	0.110	0.142	0.033	0.103	0.091	0.139	-0.101	0.142	0.153	0.030	-0.209
40		0.585	-0.063	0.304	0.237	-0.024	0.118	-0.089	0.162	0.152	-0.052	-0.033	0.036

(Continued)

TABLE 1 (Continued)
VARIMAX ROTATED FACTOR PATTERN MATRICES
FOR "WHAT IS" AND "WHAT SHOULD BE" SCALE ITEMS (n = 257)

		What Should Be							
Item	Scale	1	2	3	4	5	6	7	8
1	Respect	0.206	0.584	0.025	0.026	0.144	0.203	-0.030	0.251
2		0.122	0.660	0.197	0.099	0.101	-0.093	0.242	0.113
3		0.079	0.046	0.058	0.153	0.181	0.736	0.152	-0.054
4		0.020	0.613	0.096	0.237	0.209	0.245	0.042	-0.053
5		0.047	0.351	0.249	0.552	0.197	0.046	0.161	0.107
6	Trust	0.550	0.271	-0.093	0.265	0.128	0.078	0.130	0.224
7		0.343	0.481	0.221	0.020	0.359	0.152	0.142	-0.135
8		0.293	0.359	0.442	0.299	0.012	0.392	-0.018	0.038
9		0.412	0.337	0.176	0.447	0.029	0.226	-0.115	-0.052
10		0.302	0.043	0.298	0.054	-0.076	0.266	0.014	0.207
11	High Morale	0.261	0.388	0.220	0.300	0.390	0.112	0.183	0.140
12		0.177	0.300	0.329	0.458	0.035	0.233	0.109	0.126
13		0.364	0.081	-0.100	0.567	0.097	0.287	-0.061	0.174
14		0.121	0.051	0.317	0.439	0.172	0.338	0.202	0.161
15		0.149	0.058	0.183	0.736	0.181	-0.022	0.158	0.025
16	Input	0.369	0.091	0.113	0.216	0.517	-0.086	0.168	0.217
17		0.135	0.109	0.020	0.099	0.753	0.013	0.120	0.096
18		0.155	0.355	0.082	0.150	0.176	0.253	0.087	0.457
19		0.077	0.081	0.276	0.116	0.284	0.021	0.034	0.676
20		0.682	0.049	0.076	0.243	0.219	0.155	0.157	0.231
21	Growth	0.538	0.173	0.259	0.055	0.198	0.115	0.176	-0.095
22		0.516	0.301	0.382	0.029	0.174	0.157	0.138	0.052
23		0.307	0.254	0.161	0.096	-0.037	0.518	0.075	0.257
24		0.393	0.234	0.433	-0.033	0.346	0.268	0.106	0.010
25		0.082	0.252	0.170	0.118	0.298	0.287	0.559	-0.160
26	Cohesiveness	0.399	-0.042	0.286	0.183	0.259	0.088	-0.007	0.245
27		0.088	0.140	0.628	0.237	0.179	-0.032	0.033	0.201
28		0.176	0.285	0.236	0.175	0.507	0.125	-0.122	0.030
29		0.488	0.280	0.189	-0.043	0.209	0.329	-0.100	0.071
30		0.192	0.471	0.439	0.226	0.081	0.134	0.278	0.237
31	Renewal	0.115	0.134	0.685	0.118	0.136	0.098	0.175	0.029
32		0.523	0.405	0.064	0.188	0.165	0.036	0.164	-0.038
33		0.248	0.391	0.363	0.068	0.187	0.340	0.208	0.165
34		0.152	0.142	0.024	0.057	0.015	0.441	0.396	0.370
35		0.056	0.150	0.152	0.125	0.546	0.310	0.164	0.215
36	Caring	0.442	0.248	0.328	0.133	-0.002	0.009	0.407	0.304
37		0.506	0.210	0.460	0.160	0.089	0.184	0.172	0.107
38		0.276	0.209	0.155	0.085	0.219	0.203	0.589	0.198
39		0.560	-0.022	0.139	0.242	0.052	0.056	0.490	-0.010
40		0.326	0.488	0.282	0.183	-0.056	-0.049	0.367	0.171

Five second-order factors were extracted from the "What Is" interfactor correlation matrix, while three second-order factors were extracted from the "What Should Be" interfactor correlation matrix. The factors were rotated to the varimax criterion. Second-order factors such as these are then often interpreted. However, Gorsuch (1983), argued that this is not desirable:

> Interpretations of the second-order factors would need to be based upon the interpretations of the first-order factors that are, in turn, based upon the interpretations of the variables. Whereas, it is hoped that the investigator knows the variables well enough to interpret them, the accuracy of interpretation will decrease with the first-order factors, will be less with the second-order factors, and still less with the third-order factors. To avoid basing interpretations upon interpretations of interpretations, the relationships of the original variables to each level of the higher-order factors are determined (p. 245).

The first-order promax rotated factors, therefore, were postmultiplied by the second-order varimax rotated factors, and the product matrices (for "What Is" and "What Should Be") were then rotated to the varimax criterion. Table 2 presents these factor pattern coefficients for items that had coefficients greater than 0.3 in absolute magnitude.

TABLE 2
ROTATED PATTERN COEFFICIENTS FOR SALIENT ITEMS FOR "WHAT IS" AND "WHAT SHOULD BE" (n = 257)

	What Is	Factor						What Should Be	Factor		
Item	Scale	1	2	3	4	5	Item	Scale	1	2	3
8	Trust	.612	.048	.142	-.016	.227	4	Respect	.489	.036	.084
9	Trust	.462	.287	.160	.095	.198	7	Trust	.665	.195	-.032
11	Morale	.616	.032	.192	-.020	.032	21	Growth	.434	.297	.131
12	Morale	.435	.072	.144	.040	.128	24	Growth	.592	.154	.042
15	Morale	.654	-.153	.039	-.216	.065	28	Cohesiveness	.454	-.171	-.045
22	Growth	.386	.270	.136	.107	.133	33	Renewal	.412	.239	.156
30	Cohesiveness	.674	-.054	.108	.116	.032	3	Respect	.299	-.398	.109
31	Renewal	.574	.230	-.037	-.005	-.185	27	Cohesiveness	.201	.381	.004
33	Renewal	.539	.147	-.051	-.133	-.010	30	Cohesiveness	.252	.531	.161
36	Caring	.428	.134	-.100	.048	.000	36	Caring	-.001	.662	.229
37	Caring	.963	.294	-.195	.150	.025	38	Caring	.016	.364	-.125
38	Caring	.561	-.001	-.062	.172	.118	39	Caring	-.031	.479	.092
40	Caring	.717	-.058	.029	.043	.058	40	Caring	.152	.739	.213
3	Respect	-.094	.759	.037	-.165	.159	6	Trust	-.016	.138	.436
32	Renewal	.135	.464	.061	.095	-.141	10	Trust	.127	.161	.416
1	Respect	.020	.149	-.591	.164	.182	12	Morale	.163	.249	.303
14	Morale	-.051	-.035	-.339	-.107	-.120	13	Morale	-.126	-.231	.536
25	Growth	-.037	.230	.487	-.079	.038	20	Input	.009	.110	.339
13	Morale	-.091	-.047	.252	-.555	.039	23	Growth	.204	.013	.533
23	Growth	-.091	.021	-.071	-.488	.270					
29	Cohesiveness	-.104	.192	.167	.509	.161					
4	Respect	-.217	-.093	-.052	-.060	-.464					
18	Input	.034	.150	-.047	-.015	.536					
34	Renewal	.112	-.043	.032	-.044	.527					

Note: Salient items were items with pattern coefficients greater in absolute value than .30.

We used the generalized Kuder-Richardson reliability formula, coefficient alpha (Cronbach, 1951; Ebel, 1965; Novick & Lewis, 1967), evaluate the reliability of the instrument. This formula was appropriate since a Likert scaling format was employed. The Cronbach alphas for the "What Is" factors (subscales) follow: subscale one (.82), subscale two (.22), subscale three (.34), subscale four (.41), subscale five (.25). and the composite for all "What Is" questions (.84). The Cronbach alphas for the "What Should Be" factors

(subscales) follow: subscale one (.79), subscale two (.80), subscale three (.75), and the composite for all "What Should Be" questions (.91).

TABLE 3
SUBSCALE INTERCORRELATIONS FOR THE "WHAT IS" AND "WHAT SHOULD BE" SUBSCALES (DECIMAL POINTS OMITTED)

	"What Is" Subscale						"What Should Be" Subscale		
	I	II	III	IV	V		I	II	III
I	—	34	43	38	41	I	—	71	66
II		—	26	28	26	II		—	71
III			—	27	27	III			—
IV				—	36				
V					—				

See Table 3 for the subscale intercorrelations for the "What Is" and "What Should Be" subscales. These intercorrelations do not represent factor scores but subscale scores derived by summing the response category values for the salient items for a subscale.

DISCUSSION

The factors presented in Table 2 indicate that five second-order factors represent the eight postulated scales for the Kettering instrument. The "What Is" column questions are comprised of 24 questions for factors one through five. The factor adequacy for the "What

Should Be" questions is also given in Table 2. Factors one through three are comprised of 19 questions.

Overall, these data suggest there are five "What Is" subscales and three "What Should Be" subscales. The instrument is not structured psychometrically exactly as was originally proposed by its authors in suggesting eight "What Is" and eight "What Should Be" subscales (Fox, et. al., 1973).

The two-column response (discrepancy format) seems appropriate from a research perspective, because of its applicability in general or first-time assessment trials (Johnson & Dixon, 1984; Witkin, 1977). However, with the use of only a four-point scale, a question arises as to whether there may indeed be a reduction in the respondents' discriminative power (Jenkins & Taber, 1977; McKelvie, 1978; Rotter, 1972).

There is evidence, for example, that five-point scales are the most reliable (McKelvie, 1978), at least in measuring attitude-judgement tasks. McKelvie proposed using five or six categories. He further suggests there is not psychometric advantage in a large number of scale categories and, on the other hand, discriminative power and validity may be reduced when fewer than five categories are used.

In an agree/disagree context, Jenkins and Taber (1977) found that the number of response categories above five did not, in any situation, yield a significant increase in Likert discriminability. In addition to the fact that the literature suggests a five-or-six point scale for Likert instrumentation, in our own work we have found that the following six-category response choices recommended by Rotter (1972) seem to reflect equidistant psychological

order: 1 = disagree strongly; 2 = disagree; 3 = tend to disagree; 4 = tend to agree; 5 = agree, and, 6 = agree strongly.

CONCLUSION

Based on our analysis, the currently used subscale subdivisions may be inappropriate. The test's developers used only content validity in the construction of the test. The general test development literature suggests, however, that at least two types of validity measures be used in scale development (American Psychological Association, 1985). When the developers departed from this conventional approach to test construction, they arbitrarily designated and assigned names to various subscales in their instrument. In actuality, however, primary and second-order factor analysis shows that some of their subscales fragment and group into larger subscales. Furthermore, with the use of only a 4-point scale and the possible reduction in the respondent's discriminative power and the test's validity, at least a 5-point scale seems desirable. The suggested refinements for the Kettering scale are offered to help make the instrument more effective for a junior high school population.

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